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(54) **Evaluation of optimum risk financing for risk associated contingencies**

(57) A method of evaluating optimum risk financing for risk associated contingencies. The method assembles input data relating to the contingency and processes that data to calculate by actuarial processing for any value of retained risk, a value of premium, retained risk cost and aggregate stop. The method then identifies the optimum set of values.

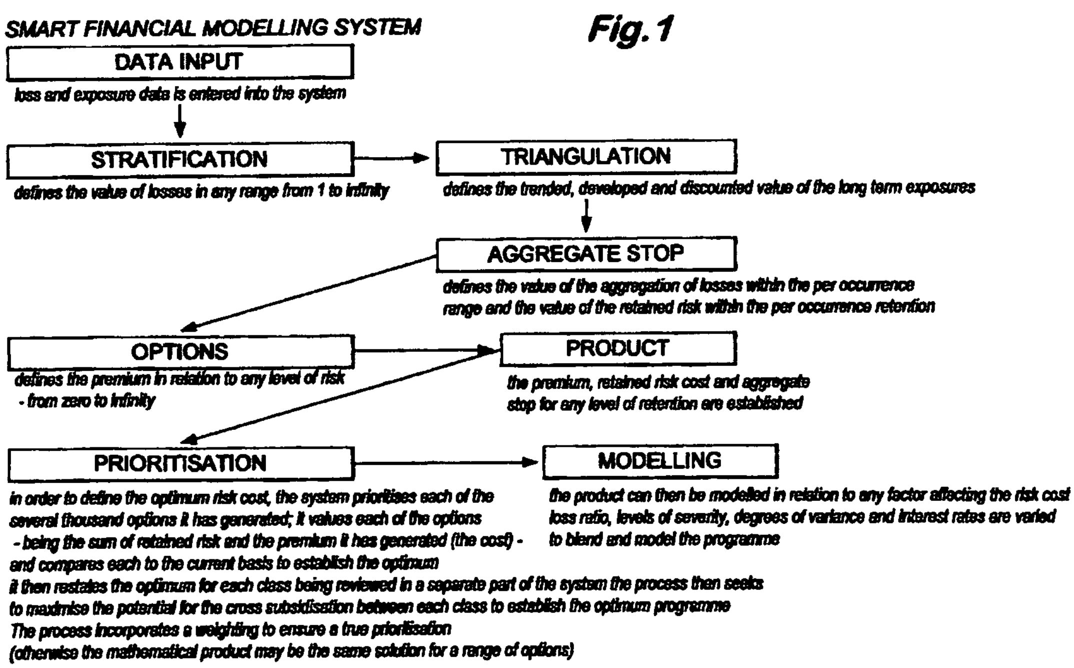

Fig. 1

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Description

[0001] This invention relates to the evaluation of optimum risk financing for risk associated contingencies.

[0002] Many organisations operate in situations where they have an exposure to risk which can result in a financial loss.. These can include injury to employees or third parties, damage to own property or third party, interruptions to the business. It is common practice to insure against such contingencies and in financing the contingencies there is generally a mixture of retained risk and insured risk for which a premium has to be paid. Traditionally, the particular balance between retained and insured risk has been evaluated as a result of statistical analysis and judgement.

[0003] Also associated with the financing of such risks is a factor known as aggregate stop which is the value of retained losses within the retention per occurrence. It represents a finite limit to retained losses in any financial period.

[0004] The present invention is concerned with a technique for evaluating optimum risk financing, that is to say values for retained risk, insured risk and aggregate stop for any risk associated contingency.

[0005] According to the present invention there is provided a method of evaluating optimum risk financing for risk associated contingencies comprising assembling input data relating to the contingency, processing said data to calculate actuarially for any value of retained risk, a value of premium, retained risk cost and aggregate stop, and identifying from the calculated values the optimum set of values.

[0006] The calculation can be performed for one or more classes of contingency. When the calculation is made for more than one class, results can be provided on a class by class basis or in combined form. The assembly of the input data includes actuarial development of that data by trending developing and discounting it to reflect the long-term nature of contingency factors. This is a recognised actuarial procedure and will be understood by those skilled in the art.

[0007] A critical step in the present method is the step of performing calculations for each of a range of values of retained risk and obtaining from those calculated values the optimum figures. This is considered to represent a significant advance in this art.

[0008] The invention will be described now by way of example only, with particular reference to the accompanying drawings. In the drawings:

Figure 1 is a flowchart illustrating the critical steps in the present method; and

Figures 2 to 7 illustrate an example of the present invention.

[0009] In essence the method is performed by a computer programme which can run on any modern PC. As can be seen from the figure the initial step in the process is data input (10). This involves inputting data from an organisation whose risk is to be assessed. Such data includes the organisations' exposure base, taking into account the various contingencies to which it is exposed, such as injury to employees or third parties, and property exposure. In addition, the organisations' current insurance programme design is entered and this should include current premium, per occurrence retention and aggregate stop, together with the loss history for each claim of exposure which is trended, developed and discounted by the system.

[0010] The next step in the sequence is that shown in the block Stratification (11). This involves defining the value of losses with any range. This is a critical step in the process as it ultimately is required to define premium, retained risk cost and aggregate stop for any level of retained risk over a range which can extend from zero to infinity.

[0011] The next step is a triangulation step (12) which defines the trended developed and discounted value of the long-term exposure of the organisation. This is a recognised actuarial process which will not be described further as it will be apparent to those skilled in the art.

[0012] The next step is to define the aggregate stop (14) which represents the value of the aggregation of losses within the per occurrence range. Again, this is a recognised concept and technique in actuarial processing.

[0013] The next step which lies at the heart of the present technique is identified as an Options step (15). In this step the system takes the aggregate stop and retained risk values at any level of retention per occurrence and calculates a premium which is a function of the difference between the total risk cost and the retained risk cost in relation to selected loss ratio. These calculations are performed using known actuarial techniques. In this way the system defines the required level of premium for any level of retention within a range which can extend from zero to infinity. The result of this step is identified on the figure as a product (16) which constitutes the premium, retained risk cost and aggregates for any level of retention within the defined range.

[0014] The next step (17) is to prioritise these values in order to define the optimum risk cost. That is to say the system prioritises each of the many thousand options it has calculated. In carrying out this step it values each of the options which are the sum of the retained risk and the premium it has generated (the risk cost) and compares each to the current basis to establish the optimum. It then restates the optimum for each class being reviewed in a separate part of the system. The process then identifies ways in which cross-subsidisation can be achieved between the various classes to establish an optimum programme covering all classes. This process incorporates a weighting to ensure a true prioritisation since otherwise the mathematical product maybe the same solution for a range of options.

[0015] Finally it is possible to model (18) the data from

the prioritisations step in order to take into account interest rates, loss ratio and degrees of variance which reflect the extent to which loss projections become increasingly volatile as levels of retention are increased in relation to the severity distribution of an organisation's loss history.

[0016] The resulting data can be presented in tabular form, either on a visual display unit or as print out. Also, it can be presented in graphical form in a similar manner.

[0017] The following example illustrates the principles underlying the present invention. This example will be described with reference to Figures 2 to 7. This example concerns a Client which is a manufacturer with a turnover of £11,355,000,000, a wage roll of £1,650,000,000 and a vehicle fleet of 4012. Its assets and Interruption exposure value is £15,345,000,000.

[0018] The Clients existing insurance is

a) Motor insurance is third party only with a deductible of £25,000 per occurrence and £1,500,000 in the annual aggregate; the premium is £325,000.
b) Employers liability cover is subject to a deductible of £50,000 per occurrence, £2,000,000 in the annual aggregate; the premium is £525,000.
c) Public and Product liability is subject to £25,000 per occurrence and £2,250,000 aggregate; the premium is £375,000.
d) Asset/Interruption has a per occurrence deductible of £100,000 and the aggregate stop is £5,000,000; the premium is £3,850,000.
e) Marine liability is subject to £5,000 per occurrence and £500,000 in the aggregate; the premium is £500,000.

[0019] Starting from this program the present system can analyse the current programme and define an optimum blend of insured and retained risk.

[0020] The method is as follows:

[0021] In order to establish the optimum programme to finance these exposures it is necessary to define:

- the premium
- the retained risk cost
- the aggregate stop

for each class evaluated and for the whole programme from a per occurrence at zero to a per occurrence where cost benefit is neutral or negative.

[0022] The Clients claims history is then loaded into the system. The system automatically adjusts this to allow for incurred but not reported losses (IBNR) and to annualise the data periods.

[0023] The data is developed by conventional actuarial techniques to reflect these factors and changes in reserves and payments over the period between notification and settlement. The system then produces a forecast for the next year which is discounted to allow for the cash flow advantage inherent in the long tail exposures.

[0024] In the present example, the Clients data period reviewed is December 31, 1993 to March 31, 1998 except for property (1992), and Marine (1994).

[0025] Figure 2 shows the data loaded and defines the ratio of trended, developed and discounted losses to premiums over the data period and the percentage of each exposure retained by the Client. For example, it can be seen that for this case the loss ratio on the motor exposure is 32.8% and the Client retained 91.48% of the loss value.

[0026] Figure 3 illustrates the loss forecast function in the system. The example shown in Figure 3 is for public/products liability - but the analysis is simultaneously produced for each of the "tail" exposures. For this class the forecast for the next financial period is in the range of £727,412 to £715,343. These figures are evaluated using known techniques.

[0027] Figure 4 illustrates the process of valuing the losses for each class in bands, ("stratification" 11 in Figure 1), as the system has to define the loss cost, premium and aggregate stop at any level of per occurrence deductible for each class. Figure 4 shows figures for Marine but corresponding figures are produced for the other exposures.

[0028] The system then establishes the aggregate stop and cost of retained risk for any level of per occurrence retention for each class. Figure 4 and Figure 5 illustrate this process and it can be seen that for the marine exposure at £500 per occurrence, the aggregate stop is £50,256, retained risk cost is £36,099; and the client retains 19•25% of the exposure; at £25,000 per occurrence, the Client would retain 97•18% of the exposure, the aggregate stop is £253,648 and retained risk projection is £182,194.

[0029] The system now contains the building blocks for defining the optimum programme. The next step is to establish the premium at any level of per occurrence retention per class and to prioritise. In this context, the sum of retained risk and premium, (the risk cost), is the criteria of prioritising.

[0030] Figure 6 illustrates prioritisation for each class across a range of per occurrence retentions.

[0031] In this example, the system has been run at current loss ratios, 5% interest/discount rate and a standard deviation factor at 0.4. It has defined a reduction in risk cost of 5.06% and the aggregate stop is at £9,500,000 from the existing £12, 750,000.

[0032] In this Figure for each class of insurance the figures in column (a) are per occurrence deductible, those in column (b) aggregate stop, those in column (c) the retained risk cost, those in column (d) the captive insurer premium, those in column (e) the maximum ceded premium, those in column (g) the percentage of risk retained by client, those in column (h) the risk cost (being the sum of retained risk and premium to the insurers), and those in column (j) are the comparison of the risk cost generated by this process and the current cost.

The figures in columns (a) to (g) have been developed earlier. The figures in column (h) are obtained for each line according to the formula

$$h=c+e$$

The figures in column (i) are the percentage change in risk cost for each line. it will be seen that in Figure 6 the optimum set of parameters for each class of insurance is marked.

[0033] The figures shown in Figure 6 are for one set of variables. The system then effectively repeats this process for an infinite number of permutations or combinations of variables and the most effective configuration is identified.

[0034] Thus it will be seen that the first part of the uniqueness of the process is that it draws together the exposure classes into a manageable form. At this stage the system defines the actuarial optimum per line - or class - and then restates each optimum as the programme design.

[0035] At this stage of the process the system is defining a fixed outcome in relation to the defined variables - each of which will generate an infinite number of outcomes. The second part of the uniqueness of the process is that it now restates the prioritised optimum - per line or class and for the whole programme - each time the variables are changed.

[0036] Ultimately, the variables are scrolled - so that prioritisation becomes dynamic and the effects can be seen immediately as the configurations are restated.

[0037] An infinite number of permutations - or combinations of variable - can be generated in this way, and the most effective configuration can be established.

[0038] The final part of the process models the programme defined in the preceding sections in relation to the following variables:

interest rates
loss ratio
levels of per occurrence retention from zero to a level at which the cost benefit is neutral or negative.
Degrees of variance, i.e. the multiples of standard deviation to reflect the distribution of loss values. A standard deviation coefficient of 2 - assuming a normal loss distribution - would mean that 95% of losses would be within the forecast.

[0039] The process then carries out curve fitting to ensure a reasonable match in the loss distribution. Monte Carlo simulations are run to test the efficacy of the loss projections in the process.

[0040] Figure 7 illustrates the modelled programme, using an interest/discount rate at 7%, a loss ratio at 85% and a standard deviation factor at 1.

[0041] This modelling and prioritising process is unique in defining the optimum risk financing programme and enables Clients and insurers to agree a medium to long term strategy for financing risk - which can be reviewed as circumstance changes. For example, as the insurance market cycle influences the loss ratio, interest rates change, new losses are notified or the Client acquires or disposes of companies.

[0042] The end product in this example is a reduction in direct risk cost of - 34.29% and an aggregate stop at £4.25m, (from £12.75m); the Client's premium becomes £5,248,148, (from £5,575,000) and retained risk is £3,201,679, (from (£7,284,633).

[0043] The following are definitives of terms used in this description:

LOSS RATIO: the ratio of losses to premiums over the data period
DEDUCTIBLE: (also referred to as the per occurrence retention); the retained amount per loss
AGGREGATE STOP: the sum of losses within the per occurrence retentions during any one insurance or fiscal period
RETENTION: the sum losses within the deductible and aggregate stop in any one insurance or fiscal period
DATA PERIOD: the frame of loss and premium history being evaluated FREQUENCY: the number of losses
SEVERITY: the value of losses
IBNR: (incurred but not reported); losses which have yet to be notified
RUN OFF: the period between occurrence and settlement of the loss
TRIANGULATION: monitors the movement of IBNR and run off to ultimate settlement to produce a forecast of the expected loss value and a settlement profile which defines the NPV
NPV: the net present value of the expected losses - at a selected discount rate - in relation to the settlement profile of the exposure.

Claims

1. A method of evaluating optimum risk financing for risk associated contingencies comprising assembling input data relating to the contingency, processing said data to calculate by actuarial processing, for any value of retained risk, a value of premium, retained risk cost and aggregate stop, and identifying from the calculated values the optimum set of values.

2. A method according to claim 1, wherein the calculation is modelled and prioritised for a plurality of variables.

3. A method according to claim 1 or claim 2, wherein the calculation is performed for one or more classes

of contingency.

4. A method according to claim 3, wherein when the calculation is made for more than one class, results are provided on a class by class basis or in combined form.

5. A method according to claim 1, wherein the assembly of the input data includes actuarial development of that data by trending developing and discounting it to reflect the long-term nature of contingency factors.

6. A system for evaluating optimum risk financing for risk associated contingencies, said system being arranged to assemble input data relating to the contingency, to process said data to calculate by actuarial processing for any value of retained risk, a value of premium, retained risk cost and aggregate stop, and to identify from the calculated values the optimum set of values.

7. A system according to claim 6, wherein the calculation is modelled and prioritised for a plurality of variables.

8. A system according to claim 6, wherein the calculation is performed for one or more classes of contingency.

9. A system according to claim 8, wherein when the calculation is made for more than one class, results are provided on a class by class basis or in combined form.

10. A system according to claim 6, wherein the assembly of the input data includes actuarial development of that data by trending developing and discounting it to reflect the long-term nature of contingency factors.

11. A computer program product comprising a computer readable medium having stored thereon computer program code which when loaded into a computer can execute the method according to claim 1.

Fig. 1

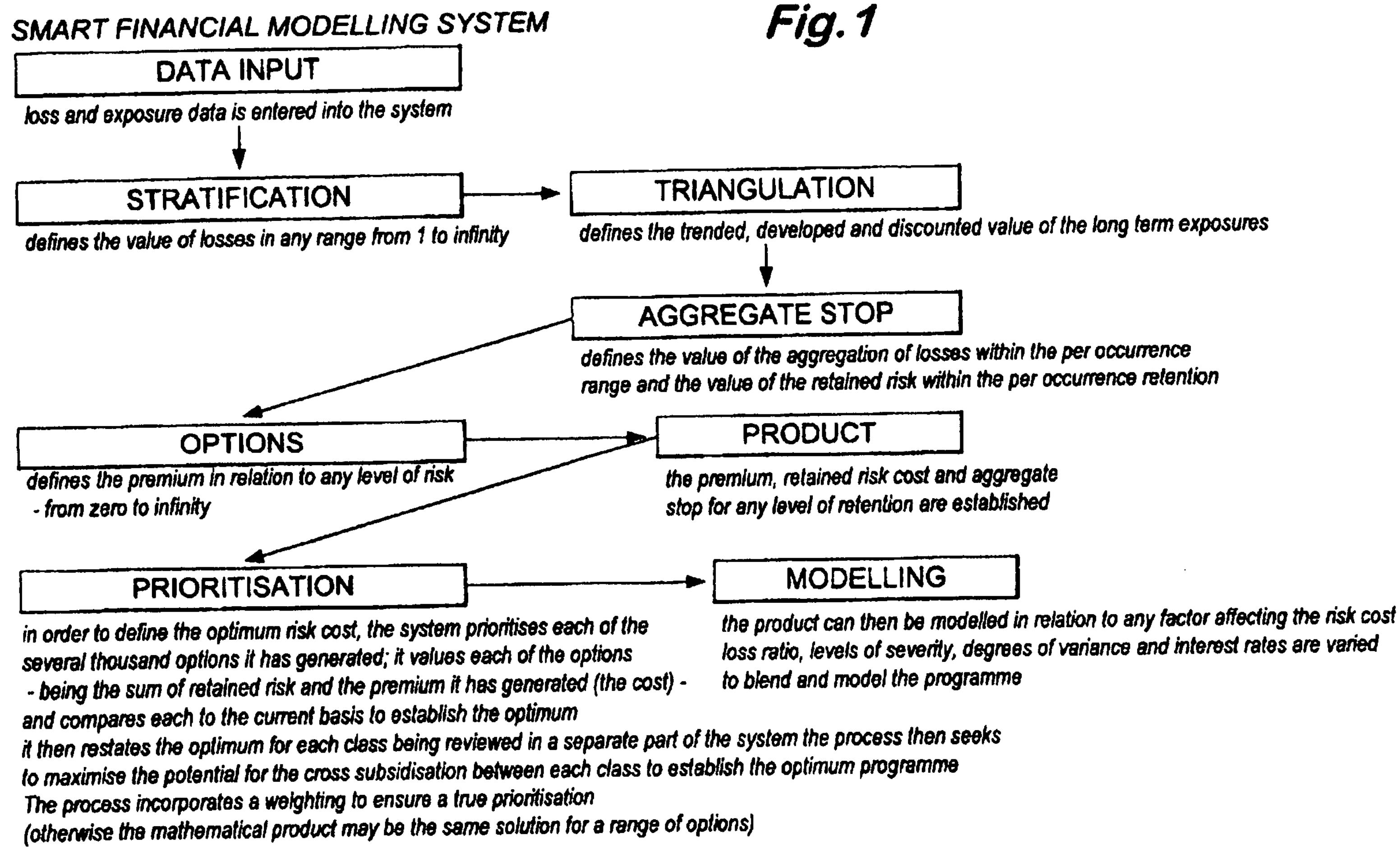

SMART FINANCIAL MODELLING SYSTEM
DATA INPUT
loss and exposure data is entered into the system
STRATIFICATION
defines the value of losses in any range from 1 to infinity
TRIANGULATION
defines the trended, developed and discounted value of the long term exposures
AGGREGATE STOP
defines the value of the aggregation of losses within the per occurrence range and the value of the retained risk within the per occurrence retention
OPTIONS
defines the premium in relation to any level of risk - from zero to infinity
PRODUCT
the premium, retained risk cost and aggregate stop for any level of retention are established
PRIORITISATION
in order to define the optimum risk cost, the system prioritises each of the several thousand options it has generated; it values each of the options - being the sum of retained risk and the premium it has generated (the cost) - and compares each to the current basis to establish the optimum
it then restates the optimum for each class being reviewed in a separate part of the system the process then seeks to maximise the potential for the cross subsidisation between each class to establish the optimum programme
The process incorporates a weighting to ensure a true prioritisation
(otherwise the mathematical product may be the same solution for a range of options)
MODELLING
the product can then be modelled in relation to any factor affecting the risk cost loss ratio, levels of severity, degrees of variance and interest rates are varied to blend and model the programme

Fig.2

Fig.2A	Fig.2B	Fig.2C
Fig.2D	Fig.2E	Fig.2F
Fig.2G	Fig.2H	Fig.2I

Fig.3

Fig.3A	Fig.3B
Fig.3C	Fig.3D

Fig.4

Fig.4A	Fig.4B

Fig.6

Fig.6A	Fig.6B	Fig.6C
Fig.6D	Fig.6E	Fig.6F
Fig.6G	Fig.6H	Fig.6I
Fig.6J	Fig.6K	Fig.6L

Fig.7

Fig.7A	Fig.7B
Fig.7C	

Fig.2A

Client: Example Insurance Company Limited

Project currency:	Exchange rate: £=	Sterling	1

Client company underwriting data:

	Mar-98	Dec-97	Dec-96
Wageroll	1,650,000,000	1,609,014,423	1,519,401,816
Employers Liability (based on Average Earning Index)			
Revenue	11,355,000,000	11,114,274,000	10,836,417,150
Public Liability (based on Rated Price Index)			
Values	15,345,000,000	15,019,686,000	14,644,193,850
Property (based on Rated Price Index)			
Fleet #	4,012	3,927	3,829
Motor TP (based on Average Claims Index Non-comprehensive - HMSO)			
Revenue - USA	0	0	0
(USA)			

Current programme:

Class	Motor	Emp. Liability	Public/prods liability
Current net ceded premium	325,000	525,000	375,000
Average ceded premium	284,375	459,375	328,125
Captive per occ. retention	0	50,000	25,000
Captive per occ. Retention-motor	25,000		
Current % captive retention	91.48%	92.90%	79.60%

Fig.2B

Dec-95	Dec-94	Dec-93	Dec-92
1,447,423,263	1,358,832,100	1,247,559,722	1,145,399,244
10,663,034,476	10,268,502,200	9,662,660,570	9,015,262,312
14,409,866,748	13,876,720,939	13,057,994,403	12,183,108,778
3,768	3,628	3,414	3,185
0	0	0	0

Asset/interruption	Marine
3,850,000	500,000
3,368,750	437,500
100,000	5,000
44.97%	89.01%

Fig.2C

Dec-91	Dec-90
1,051,604,508	965,490,459
8,510,407,623	8,033,824,796
11,500,854,687	10,856,806,824
3,007	2,839
0	0

Fig.2D

Aggregate stop on captive retention	1,500,000	2,000,000	2,250,000
Cross class aggregate stop	1,500,000	2,000,000	2,250,000
Data Period from	31-Dec-93	31-Dec-93	31-Dec-93
Data Period to	31-Mar-98	31-Mar-98	31-Mar-98
Renewal Date	31-Mar-98	31-Mar-98	31-Mar-98
Loss Ratio:		PER CLASS:	Motor
Selected reinsurer ratio:	85.00%		
Seleted captive ratio:	90.00%		
Captive minimum premium:	5.00%	(Rate on line)	
Current Programme ratio:	35.66%		85.00%
Catastrophe Reserve:	25.00%		25.00%
Discount Rate:	107.00%	(Rate on line)	50
Minimum severity:	500		100
Fund factor:	1	(deviation factor)	
Agg stop rounding:	250,000		
Incurred losses* (year to):	Mar-98	Dec-97	Dec-96
Motor ad	0	0	0
(frequency)	1	1	1
Exceeding agg stop	0	0	0
Motor tp	181,471	771,748	1,249,646
(frequency)	142	352	510

Fig.2E

5,000,000	5,000,000
5,000,000	500,000
31-Dec-92	31-Dec-94
31-Mar-98	31-Mar-98
31-Mar-98	31-Mar-98

Emp. Liability	Public/prods liability	Asset/interruption	
85.00%	**85.00%**	**85.00%**	**85.00%**
25.00%	25.00%	25.00%	25.00%
0.10%	0.02%	0.03%	0.04%

Dec-95	Dec-94	Dec-93	Dec-92
0	0	0	0
1	1	1	1
0	0	0	0
691,853	697,249	0	0
420	462	0	0

Fig.2F

Dec-91	Total
0	1
1	
0	0
0	3,591,967
0	

Fig.2G

Exceeding agg stop	0	0	0
Asset/interruption	530,583	3,440,291	2,601,689
(frequency)	36	146	103
Exceeding agg stop	0	0	0
Exp. Liability	238,500	829,561	1,301,703
(frequency)	24	144	201
Exceeding agg stop	0	0	0
Public/prods liability	157,953	748,823	425,602
(frequency)	53	239	161
Exceeding agg stop	0	0	0
Marine	70,893	151,202	120,834
(frequency)	19	73	63
Exceeding agg stop	0	0	0
(* net of non ranking deductible)			
	0	0	0
Recoveries:	10%		

Fig.2H

0	0	0	0
6,276,665	146,807	1,528,632	0
153	192	85	0
0	0	0	0
1,258,983	1,364,539	0	0
220	205	0	0
0	0	0	0
444,616	434,344	0	0
140	129	0	0
0	0	0	0
99,695	0	0	0
57	0	0	0
0	0	0	0
0	0	0	0

Fig.2I

0	0
0	14,524,666
0	
0	0
0	4,993,286
0	
0	0
0	2,211,336
0	
0	0
0	442,624
0	
0	0
0	0

Fig.3A

FREQUENCY	Public/prods liability	Client: Example Insurance Company Limited		07/31/98
Year Incurred	Valn Month*	Claim Count	Cum Dev Factor*	Ult Claim Count
Dec-91	96	0	1.00	0
Dec-92	84	0	1.00	0
Dec-93	72	0	1.00	0
Dec-94	60	129	0.97	125
Dec-95	48	161	1.09	175
Dec-96	36	161	1.24	199
Dec-97	24	239	1.24	263
Dec-98	12	213	1.24	263
SEVERITY		c	d	e
Year Incurred	Valn Month	Losses	Cum Dev Factor*	Trend Factor
Dec-91	96	0	1.00	135.54%
Dec-92	84	0	1.00	128.35%
Dec-93	72	0	1.03	120.29%
Dec-94	60	434,344	1.13	113.59%
Dec-95	48	444,616	1.25	109.54%
Dec-96	36	425,602	1.59	107.81%
Dec-97	24	748,823	1.59	105.18%
Dec-98	12	633,546	2.15	103.00%
	*(From Inception)		Industry database used	Based on Retail Price Index

Exposures				
Policy Year	Revenue	Trend Factor	Trended Revenue	
Dec-91	8,033,825	135.54%	10,889,076	0
Dec-92	8,510,408	128.35%	10,923,331	0

Fig.3B

Development limiter			
Severity:	0.86	MAX	1.59
	0.72	MIN	0.14
Frequency:	0.63	MAX	1.24
	0.61	MIN	0.02

Ult Trended Losses
0
0
0
533,710
585,095
703,893
1,207,109
1,363,543

NPV @
average paid each year as
0.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5

RATES		
Freq per Exp	Loss per Exp	Ave Sev
0.0000%	0.00	0
0.0000%	0.00	0

Dec-93	9,015,262	120.29%	10,844,729		0
Dec-94	9,662,661	113.59%	10,975,924		5
Dec-95	10,268,502	109.54%	11,247,933		4
Dec-96	10,663,034	107.81%	11,496,158		3
Dec-97	10,836,417	105.18%	11,398,134		2
Mar-98	11,114,274	103.00%	11,447,702		1
	1,000	Based on Retail Price Index		AVERAGE	
				DATA YEARS	
Freq X Sev Forecast				TOTAL	
Policy Year	Revenue	Freq per Exp	Forecast Claims	Ave Severity	
Mar-99	11,447,702	0.0019%	213.60	4,078	
Loss per Exposure Forecast					
Policy Year	Revenue	Loss per Exp	Forecast Losses		
Mar-99	11,447,702	0.08	885,793		
			Forecast loss value over settlement profile		
			448,815	433,886	
			0	0	
			0	0	
			0	0	
			104,260	76,894	
			130,418	89,893	
			117,403	75,629	
			84,897	51,111	
				727,412	
			@ settlement pattern		
			and fund interest rate	7.00%	
			885,793	82.12%	

Fig.3C

0.0000%	0.00	0
0.0011%	0.05	4,266
0.0016%	0.05	3,335
0.0017%	0.06	3,531
0.0026%	0.11	4,079
0.0023%	0.12	5,180
0.0019%	0.08	4,078
5	5	5
0.0093%	0.39	20,391
Forecast Losses		
871,096		

Forecast loss value over settlement profile	
441,368	426,687
0	0
0	0
0	0
102,530	75,618
128,254	88,402
115,455	74,374
83,488	50,263
	715,343
@ settlement pattern	
and fund interest rate	7.00%
871,096	82.12%

Fig.3D

Fig.4A

Mean + (standard deviation * T factor)			
T factor to the median of 75th and 95th percentile		261,019	
			Marine
	years		Deductible
	4	166,485	500
	3	195,782	1,000
	2	143,473	2,000
	1	77,649	5,000
			10,000
			15,000
			20,000
			25,000
total		545,890	30,000
mean average X large loss factor		179,542	40,000
maximum		195,782	5,000
minimum		77,649	
standard deviation X large loss factor		53,705	
Years Data:		3	standard deviation X:
			93.27%
			Single large loss:
			As factor of total:

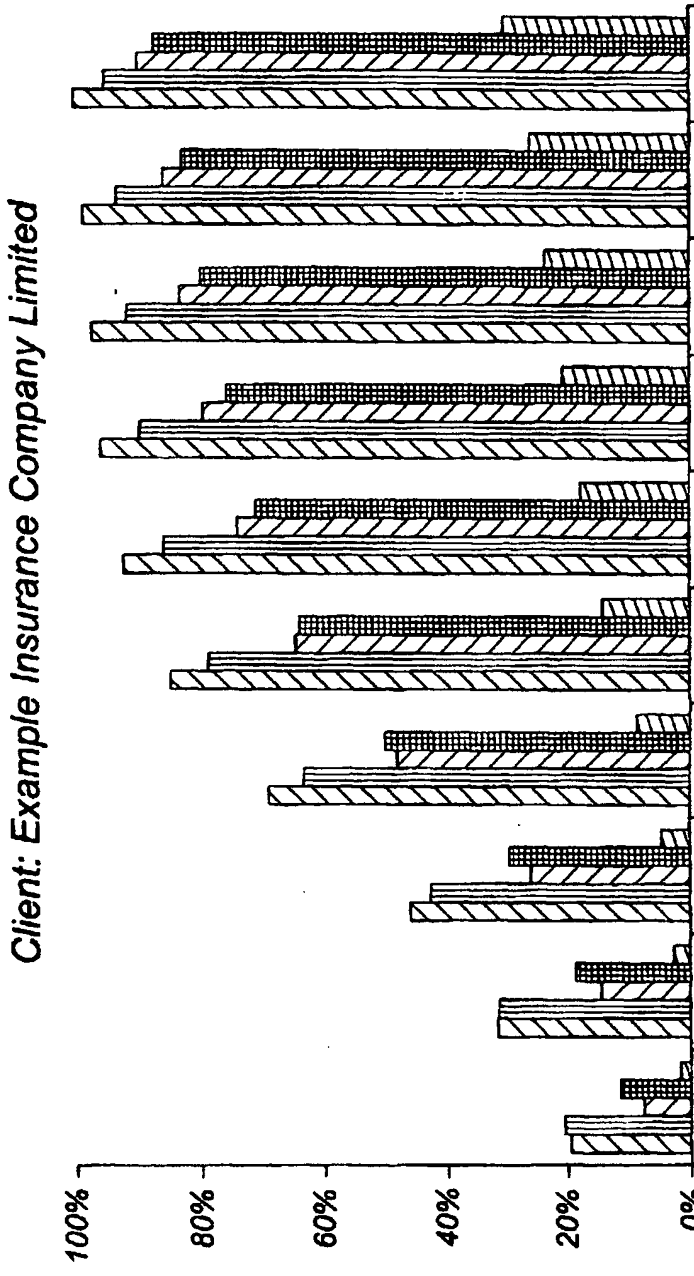
Fig.4B

		187,489
% of risk retained	agg stop	Fund
19.25%	50,256	36,099
31.87%	83,175	59,744
45.99%	120,035	86,221
69.01%	180,141	129,394
84.61%	220,850	158,635
92.04%	240,246	172,567
95.46%	249,169	178,977
97.18%	253,648	182,194
98.31%	256,597	184,312
100.00%	261,019	187,489
69.01%	180,141	129,394

0.4

37,500
1.07

Fig.5



Severity 0 to:	500	1,000	2,000	5,000	10,000	15,000	20,000	25,000	30,000	40,000
Marine	19.25%	31.87%	45.99%	69.01%	84.61%	92.04%	95.46%	97.18%	98.31%	100.00%
Motor tp	20.46%	31.24%	42.91%	63.35%	78.63%	85.52%	89.22%	91.48%	93.07%	95.03%
Emp. Liability	7.56%	14.32%	25.57%	48.01%	64.73%	74.02%	79.33%	83.13%	85.63%	89.67%
Public/prods liability	11.42%	18.74%	29.60%	50.17%	64.06%	71.01%	75.74%	79.60%	82.62%	86.92%
Asset/interruption	1.78%	2.88%	4.64%	8.63%	14.05%	17.72%	20.92	23.82%	26.17%	30.28%

Fig.6A

	(a)	(b)	(c)
07/31/98		Client: Example Insurance Company Limited	
PROGRAMME DESIGN			
CLASS	Deductible	Aggregate Stop	Captive Retention
Motor	2,000	1,250,000	698,987
Motor tp	5,000	1,500,000	1,031,968
Selected reinsurer ratio:	10,000	2,000,000	1,280,807
36.00%	15,000	2,250,000	1,393,143
	20,000	2,250,000	1,453,353
	25,000	2,250,000	1,490,188
	30,000	2,250,000	1,516,066
	40,000	2,250,000	1,548,038
Selected captive ratio:	25,000	2,250,000	1,490,188
90.00%	25,000	1,500,000	1,490,188
	Current basis		

Reinsurers Catastrophe Reserve:

Emp. Liability	2,000	750,000	511,631
Selected reinsurer ratio:	5,000	1,500,000	960,742
36.00%	10,000	1,750,000	1,295,257
	15,000	2,000,000	1,481,168
	20,000	2,250,000	1,587,426

Fig.6B

(d)	(e)	(f)
Captive Premium	Maximum Ceded Premium	Market Reinsurance Premium
776,652	2,004,084	
1,146,632	1,275,051	
1,423,119	742,917	
1,547,937	503,163	
1,614,836	374,693	
1,655,764	312,807	325,000
1,684,518	312,807	
1,720,043	312,807	
1,655,764	312,807	325,000
1,655,764	325,000	

25.00%

312,807

568,478	4,239,827	
1,067,491	2,934,949	
1,439,175	1,989,375	
1,645,743	1,465,196	
1,763,807	1,165,692	

Fig.6C

(g) % of risk retained by captive	(h) Risk Cost	(i) +/-%	
42.91%	2,703,071	48.91%	
63.35%	2,307,019	27.10%	
78.63%	2,023,724	11.49%	
85.52%	1,896,306	4.47%	
89.22%	1,828,045	0.71%	
91.48%	1,802,995	-0.67%	
93.07%	1,828,873	0.75%	
95.03%	1,860,845	2.52%	
91.48%	1,802,995	-0.7%	Optimum
91.48%	1,815,188	0.00%	
Annualised loss cost:	1,251,228		
% to:	100.00%		

25.57%	4,751,457	99.31%
48.01%	3,895,691	63.41%
64.73%	3,284,632	37.78%
74.02%	2,946,364	23.59%
79.33%	2,753,118	15.49%

Fig.6D

	25,000	2,250,000	1,663,469
	30,000	2,250,000	17,133,530
Selected captive ratio:	40,000	2,250,000	1,794,371
90.00%	50,000	2,750,000	1,858,943
	50,000	2,000,000	1,858,943
	Current basis		

		Reinsurers Catastrophe Reserve:	
Public/prods liability	2,000	500,000	238
Selected reinsurer ratio:	5,000	750,000	403,944
36.00%	10,000	750,000	515,809
	15,000	1,000,000	571,757
	20,000	1,000,000	609,859
	25,000	1,000,000	640,879
	30,000	1,000,000	665,231
	40,000	1,000,000	699,848
	25,000	1,000,000	640,879
	25,000	2,250,000	640,879
	Current basis		

		Reinsurers Catastrophe Reserve:	
Asset/interruption	2,000	500,000	180,392
Selected reinsurer ratio:	5,000	750,000	335,897
36.00%	10,000	1,000,000	546,686
	15,000	1,250,000	689,487
	20,000	1,500,000	813,727

Fig.6E

1,848,299	951,363	
1,903,922	810,264	
1,993,745	582,412	
2,065,492	507,590	525,000
2,065,492	525,000	

25%

264,813	1,499,997	
448,827	1,052,279	
573,121	758,210	
635,286	611,550	
677,621	511,716	
712,087	430,441	325,000
739	366,635	
777,609	275,936	
712,087	430,441	325,000
712,087	375,000	

25%

200,436	377,541	
373,219	214,655	
607,429	106,515	
766,097	62,286	
904,141	62,286	

Fig.6F

83.13%	2,614,832	9.69%	
85.63%	2,523,794	5.87%	
89.67%	2,376,783	-0.30%	
92.67%	2,366,533	-0.73%	Optimum
92.90%	2,383,943	0.00%	

Projected loss cost:* 2,030,361

607,590

29.06%	1,738,329	71.12%	
50.17%	1,456,223	43.35%	
64.06%	1,274,019	25.41%	
71.01%	1,183,308	16.48%	
75.74%	1,121,575	10.40%	
79.60%	1,071,320	5.46%	
82.62%	1,031,867	1.57%	
86.92%	975,784	-3.95%	Optimum
79.60%	1,071,320	5.5%	
79.60%	1,015,879	0.00%	

Projected loss cost:* 759,454

189,688

4.64%	7,583,277	35.43%
8.63%	7,365,258	31.54%
14.05%	7,153,204	2775.00%
17.72%	7,013,259	25.25%
20.92%	6,891,966	23.08%

Fig.6G

	25,000	1,750,000	926,726
	30,000	2,000,000	1,018,144
	40,000	2,250,000	1,177,864
	100,000	3,250,000	1,749,382
	100,000	5,000,000	1,749,382
	Current basis		
		Reinsurers Catastrophe Reserve:	
Marine	2,000	250,000	86,221
Selected reinsurer ratio:	5,000	250,000	129,394
36.00%	10,000	250,000	158,635
	15,000	250,000	172,567
	20,000	250,000	178,977
	25,000	500,000	182,194
	30,000	500,000	184,312
	40,000	500,000	187,489
	5,000	250,000	129,394
	5,000	500,000	129,394
	Current basis		
		Reinsurers Catastrophe Reserve:	
PROGRAMME	2,000	2,750,000	1,715,562
Selected reinsurer ratio:	5,000	4,750,000	2,861,946
36.00%	10,000	6,000,000	3,797,195
	15,000	7,000,000	4,308,123
	20,000	7,500,000	4,643,341

Fig.6H

1,029,695	62,286	
1,131,271	62,286	
1,308,738	62,286	
1,943,758	214,441	3,850,000
1,943,758	500,000	

25%

95,801	7,402,884	
143,771	7,029,361	500,000
176,261	6,606,518	
191,741	6,323,772	
198,863	6,078,239	
202,438	5,854,969	
204,791	5,674,341	
208,321	5,358,764	
143,771	4,229,547	500,000
143,771	3,850,000	

25%

1,906,180	15,524,333
3,179,940	12,506,295
4,219,106	10,203,535
4,788,804	8,965,967
5,159,268	8,192,626

Fig.6I

23.82%	6,781,694	21.12%	
26.17%	6,692,486	19.52%	
30.28%	6,536,628	16.74%	
44.97%	5,978,929	6.78%	
44.97%	5,599,382	0.00%	Optimum

Projected loss cost:* 2,766,564

691,741

45.99%	463,762	-26.32%	
69.01%	344,049	-45.34%	
84.61%	265,151	-57.87%	
92.04%	234,853	-62.69%	Optimum
95.46%	241,263	-61.67%	
97.18%	244,480	-61.16%	
98.31%	246,598	-60.82%	
100.00%	249,775	-60.32%	
69.01%	343,835	-45.4%	
69.01%	629,394	0.00%	

Annualised loss cost: 249,142

20.15%	17,239,896	50.65%
33.62%	15,368,241	34.29%
44.61%	14,000,731	22.34%
50.61%	13,274,091	15.99%
54.55%	12,835,968	12.17%

Fig.6J

25,000	7,750,000	4,903,455
30,000	8,000,000	5,097,284
40,000	8,500,000	5,407,611
Current ret.	8,750,000	5,868,786
Blend	9,500,000	5,970,928
Current basis	12,750,000	5,868 ,786

Blend	Deductible	
Motor tp	25,000	25,660
Emp. Liability	50,000	50,000
Public/prods liability	40,000	26,660
Asset/interruption	100,000	100,000
Marine	15,000	5,660
+/-%	-4.06%	

Fig.6K

5,448,284	7,611,865	
5,663,649	7,226,333	
6,008,456	6,592,204	
6,520,873	5,694,826	
6,634,365	5,068,619	5,575,000
6,520,873	5,575,000	

	Annualised loss cost:
Premium @ selected loss ratio & nil retention:	19,603,192
Reinsurers Catastrophe Reserve:	1764287

Modelling factors	
Project currency:	Sterling
Selected reinsurer ratio:	86%
Selected captive ratio:	90%
Current Programme ratio:	35.97%
Discount Rate:	5%
Fund factor:	0.40
Cross class aggregate:	no
Use trend factor:	no
Minimum severity:	500
Agg stop rounding:	250,000

Fig.6L

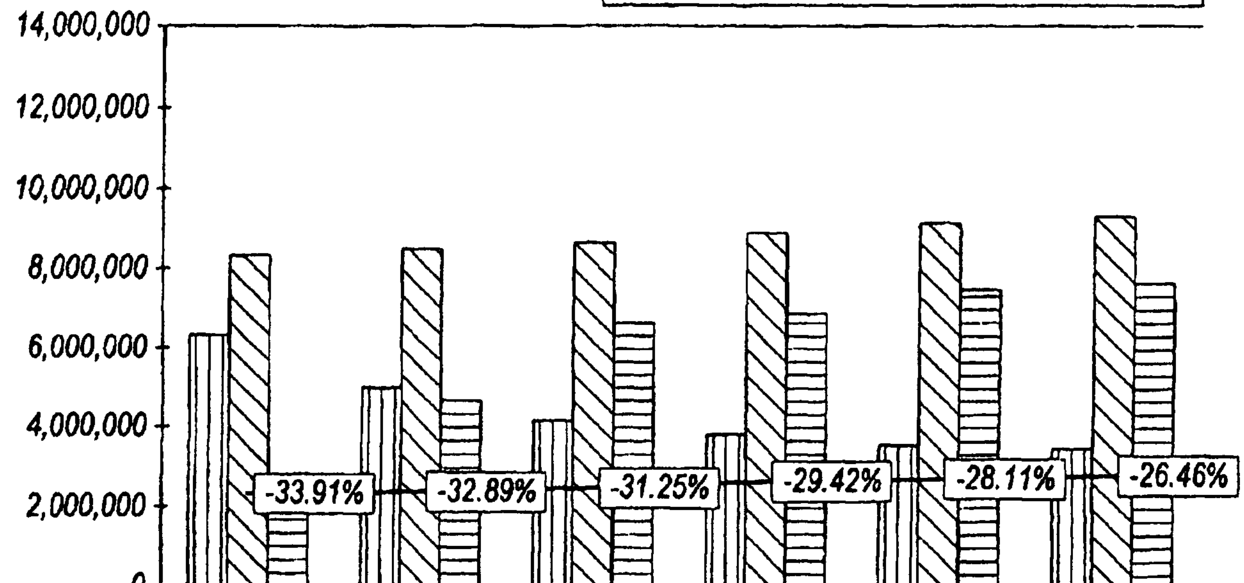
57.60%	12,515,320	9.36%
59.88%	12,323,618	7.69%
63.52%	11,999,815	4.86%
68.94%	11,563,612	1.05%
70.14%	10,979,548	-4.06%
68.94%	11,443,786	0.00%
7,057,149		

Optimum
36.00%

Fig.6X

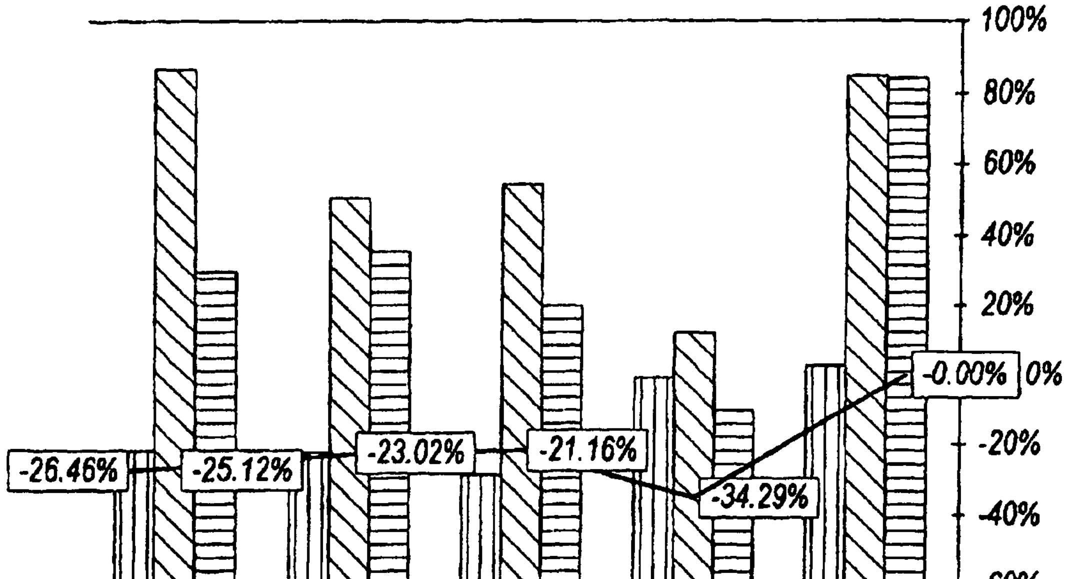
Blend	Deductible	Current Deductible	Modelling Factors	
			Project currency:	Sterling
			Selected reinsurer ratio:	30%
			Selected captive ratio:	90%
			Current Programme ratio:	35.97%
Motor tp	25,000	25,000	Discount Rate:	5.00%
Emp. Liability	50,000	50,000		
Public/prods liability	40,000	25,000	Fund factor:	0.40
Asset/interruption	10,000	10,000		
Marine	5,000	5,000	Cross class aggregate:	no
+/-%	-4.00%		Use trend factor:	no
			Minimum severity:	500
			Agg stop rounding:	250,000

Fig. 7A



Per occurrence:	2,000	5,000	10,000	15,000	20,000	25,000
Ceded premium	6,454,437	5,215,137	4,284,150	3,888,474	3,634,845	3,514,766
Risk Cost	8,498,867	8,630,648	8,841,346	9,076,376	9,244,909	9,456,857
Agg Stop	2,750,000	4,750,000	6,000,000	7,000,000	7,5000,000	7,750,000
+/- %	-33.91%	-32.89%	-31.25%	-29.42%	-28.11%	-26.46%
@ loss ratio	85.00%					

Fig. 7B



30,000	40,000	Current ret.	Blend	Current basis
3,438,265	3,304,609	2,854,220	5,248,148	5,575,000
9,629,822	9,898,994	10,138,853	8,449,828	12,859,633
8,000,000	8,500,000	8,750,000	4,250,000	12,750,000
-25.12%	-23.02%	-21.16%	-34.29%	0.00%

Blend	Deductible
Motor tp	2,000
Emp. Liability	15,000
Public/prods liability	2,000
Asset/interruption	2,000
Marine	5,000
+/-%	-34.29%

Modelling factors	
Project currency:	
Selected reinsurer ratio:	85.00%
Selected captive ratio:	90.00%
Current Programme ratio:	35.66%
Discount Rate:	7.00%
Fund factor:	1.00
Cross class aggregate:	no
Use trend factor:	no
Minimum severity:	500
Agg stop rounding:	250,000

Loss ratio

Discount rate

Fund factor

Minimum severity

Fig. 7C